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Tapping the expertise within

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Abstract

”Universities have a wealth of academic expertise from a wide range of disciplines that can be utilised for students in the form of guest presentations. This paper describes successful guest presentations in nuclear radiation that were given to students enrolled in environmental and security degree courses. Each presentation consisted of fundamental nuclear radiation science, human applications, in-context examples and discussions. Student feedback and evaluation was overwhelmingly positive with students giving high overall satisfaction rates for presentations they regarded as useful and relevant. The role of guest teaching in the wider context of tapping the expertise within institutions is also explored.”

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Introduction

How widely and how well do universities tap into the vast expertise and life experiences of staff from within their own institutions? What role do guest lectures/seminars/presentations play in the education of university students? How effective can guest teaching be if student backgrounds and degree course details are unfamiliar to the presenter? What follows is a case study and investigation from the perspective of physics through which these questions are explored.

Australian university physics departments are responsible for significant teaching of service physics units, also known as subjects, to students in non-physics degree courses (Sharma et al, 2005). Physics lecturers have demonstrated innovative and flexible approaches to deliver physics units to students (Mendez et al, 2005). However, physics is also relevant to many other university courses in which there are no physics service units. For example, most science or health related courses at university will contain elements of physics within their core units. With the wide usage of radioisotopes in industry, research, and medicine, the topic of nuclear radiation is an excellent example of specialist physics knowledge that should be useful, albeit in small doses, in many university courses with no service physics units.

The initial request in 2006 for a physics guest teacher in nuclear radiation was from the coordinator of environmental science. The presentation was well received and in 2007 improved, updated and tailored presentations on nuclear radiation were given to two separate cohorts of ECU (Edith Cowan University) students. The first cohort of students was enrolled in a third year undergraduate unit entitled “SCI3206 Environmental Investigation and Monitoring” as part of a Bachelor of Environmental Health or Bachelor of Science (Environmental Forensics) degree. The second cohort of students was enrolled in a unit entitled “SCY5112 Current Issues in Security Science” as part of a Masters of Security Management or Master of Science (Security Science) degree. Neither cohort had a physics unit in their degree nor any requirement for upper high school physics to gain entry to their course. The presentations to the two cohorts had similar content but differed in context and specific applications.

In this paper, the place of guest teaching by university staff (internal) is discussed in the context of other physics teaching at university. The nuclear radiation presentations are outlined and the results of student evaluations given and discussed. The wider use of guest lecturers/presenters at university and some implications for practice are also discussed.

Physics Teaching in University Units and Guest Presentations

Physics teaching in university units might be divided into the “traditional” teaching, which over decades in Australia provided almost the entire student teaching load within a physics department, and the more “opportunistic” teaching in new or boutique areas that vary enormously between institutions and can eventuate in a variety of ways. Ways of teaching by physics staff within university units include:

- Physics units in physics and associated physics-rich courses within physics departments.
- Traditional service teaching units in courses (like engineering) for which physics is commonly taught and assessed within physics departments. Unfortunately the amount of teaching here seems to be in decline.
- Opportunistic service teaching units in non-traditional areas. A recent ECU example would be “SCP1132 Introduction to Physics” for students enrolled in a forensic science degree within the Faculty of Business and Law.
- Shared units. An archived ECU example would be “SCI1173 Home and Consumer Science 1” for Applied Science (Consumer Science) students where the teaching was shared equally between chemistry and physics staff.
- Guest presentations, like the one described in this paper.

Guest presentations differ from the other types of teaching listed in that there is no payment to the physics department and no workload allocation to the physics staff member. It is voluntary, on invitation, and does not usually require the knowledge (and therefore permission) of the line manager who may or may not approve of such endeavours. Guest teaching provides a way of delivering expertise in small chunks to students who would otherwise miss out. It can also provide a stimulating challenge for an educator to reach a new audience and gain satisfaction in educating a wider range of students and supporting or collaborating with colleagues from different disciplines.

Nuclear Radiation Presentation

The nuclear radiation presentation contained the basic science, human applications, demonstrations (for the security cohort), dosage, and contextualised examples. It took approximately one and a half hours for the environmental cohort, and just over two hours for the security cohort due to practical demonstrations and additional issues that were discussed. The content was primarily derived from material found in common physics textbooks (Halliday et al, 2005; Hewitt, 2006; Serway and Jewett, 2004; Thornton and Rex, 2006). Short demonstrations with radioisotopes were integrated into the presentation for the security cohort and offered as an optional extra after the presentation for the environmental cohort.

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Basic Science

The basic science that underpins nuclear radiation and its applications can be presented at a level appropriate to students from a non-mathematical or physical science background. The basic science section consisted of:

- Human Radiation Exposure: The origins of ionising radiation exposure for the average individual. This served primarily as a motivational opener to engage students.
- Atoms: Atomic Structure and the periodic table, atomic and mass numbers, symbols, isotopes. This section was covered more quickly with the environmental cohort who had completed a chemistry unit as part of their course.
- Radioactive Decay: Stability, spontaneous decay modes (alpha, beta-, beta+, gamma), decay type from magnetic field, nuclear equations (alpha, beta+, beta-, gamma).
- Decay characteristics: half life, activity (becquerel and curie), penetration (alpha, beta gamma), detection (Geiger counter). The basic science section took about 40 minutes and was the longest section of the presentation.

Human Applications

A variety of example applications were chosen to demonstrate the wide use of radioisotopes in society and to consolidate their basic science. Many of the general examples had application in the contexts of both “environmental” and “security” students. Applications with significant coverage were:

- Carbon dating (beta emission)
- Household smoke detectors (alpha emission)
- Tracers (gamma emission)
 - o Pipe leaks & fluid flow
 - o Medical (blood circulation, bone scans, etc.)
- Food irradiation
- Radiation therapy
 - Neutron activation
 - o Explosives detection
 - o Forensics (e.g. art forgeries)

Demonstration

A Geiger counter was set up to detect nuclear radiation from some low activity (~ 1 microcurie) radioactive sources. Short practical demonstrations were done to show students:

- the spontaneous nature of radioactive decay
- the effect of distance on the count rate
- the different penetrating ability of alpha, beta and gamma radiation using paper, cardboard, aluminium and lead.

The demonstrations were very interactive with students predicting, asking questions, and discussing their observations. This section was only part of the presentation for the security cohort, although an optional demonstration was conducted for just over half of the environmental cohort who walked across campus to the physics laboratory after their presentation was finished and had been evaluated.

Radiation Exposure

This section and the basic science section were the least interactive sections and therefore deliberately separated to help maintain student interest and attention. After covering the general effects of radiation exposure, the absorbed dose (gray, rad, roentgen) and dose equivalent (sievert, rem) quantities were defined. X-rays and charged particles were introduced as ionising radiation that is included in the dosage. The average annual human radiation exposure by source was then discussed in more detail, and the role of Australian regulatory authorities and some standards presented.

Contextualised examples

The 1987 Goiânia incident in Brazil, where a single Cesium-137 source from an abandoned radiotherapy clinic was partially dispersed in the community, is a highly illustrative case for the course contexts of both cohorts of students. It resulted in four deaths, 249 contaminated people, 112,000 people monitored for radiation effects, and 3500m³ of radioactive contaminated waste removed (De Jong, 1990). For the security cohort, this incident was presented in the context of a Radiological Dispersal Device.

Student evaluation

At the end of both presentations, all students completed an anonymous student feedback sheet. Firstly, they were asked for their background in physics and nuclear radiation. Secondly, they responded to a series of positively worded statements on a 4-point scale (strongly agree, agree, disagree, strongly disagree) regarding the presentation and rated the difficulty of the material presented. Finally they were invited to write comments on any aspect of the presentation. Regardless of physics background, student responses were overwhelmingly positive and no student strongly disagreed with any statement.

SCI3206 Environmental Investigation and Monitoring Cohort Summary

In this cohort, the entire class of 17 students completed the anonymous student feedback sheet, with 8 students reporting some background in either physics (above year 10) or nuclear radiation. Only 6 students reported that they had at some time previously covered nuclear radiation at this level or above.

All students responded that their understanding and knowledge of “the science of nuclear radiation” as well as “human applications of nuclear radiation” had definitely increased. A good understanding of the science of nuclear radiation was considered necessary by 94% for good application in environmental investigation and monitoring. 88% of students reported that their appreciation and understanding of how nuclear radiation might be used in environmental investigation and monitoring had definitely increased, with the same proportion of students wanting to learn more about nuclear radiation within this context.

The amount and difficulty of the material presented was considered “about right” by 88% of the surveyed students. All students believed the presentation was relevant to their needs and all students reported that overall they were satisfied with the presentation. Although few students made comments, two students did suggest more environmental examples be provided in future.

SCY5112 Current Issues in Security Cohort Summary

In this cohort, the entire class of 23 students completed the anonymous student feedback sheet with 8 students reporting no background in either physics (above year 10) or nuclear radiation, 9 students having some physics but no nuclear radiation, and 6 students with physics and nuclear radiation background at this level or above.

All students responded that their understanding and knowledge of “the science of nuclear radiation” had definitely increased. A good understanding of the science of nuclear radiation was considered necessary by 91% to identify security issues and evaluate risk with 96% of students believing that their appreciation and understanding in this context had definitely increased.

The amount and difficulty of the material presented was considered “about right” by 78% of the students with 91% being overall satisfied with the presentation. In the comments section, two students suggested more security applications be provided in future.

Student background and evaluation of presentation

Students were asked whether the amount and difficulty of the material presented was low (i.e. too little/easy), medium (i.e. about right) or high (i.e. too much/difficult). The individual responses (see table 1.) clearly demonstrate that regardless of background, students believed that the amount and difficulty of material presented was “medium (i.e. about right)”.

Background	Low (i.e. too little/easy)	Medium (i.e. about right)	High (i.e. too much/difficult)	Other/Unclear
No physics or nuclear radiation	0	13	2	2
Physics only (no nuclear radiation)	0	10	0	1
Nuclear Radiation only (no physics)	0	1	0	0
Both physics and nuclear radiation	1	9	1	0

Table 1: Student responses by background to “The amount and difficulty of material presented was...”. Students not clearly selecting one of the three answers are grouped under “Other/Unclear”.

While the presentation was primarily aimed at students with little or no background, some more advanced physics was briefly covered for the more able students. For example, using the exponential decay equation for sample size after any time – not just integral numbers of half lives, was also briefly discussed. In addition, the author was constantly trying to engage students’ previous knowledge on a number of levels. Even so, the uniformly high satisfaction rates with the overwhelming belief that the material was at the appropriate level of difficulty for students across such a wide range of backgrounds was unexpected and is somewhat puzzling as it appears to counter some widely held “constructivist” views on good teaching and student learning. For example, Biggs (2003, p76) relates the story of a physics professor telling his students to forget their simplistic high school physics so that they could learn real physics as an example of how not to teach because it does not build on the known. In physics, the conceptual knowledge and skill set of students is often critical in choosing appropriate content and pedagogy. These nuclear radiation presentations seem to be very resilient to different student backgrounds.

Guest Teaching at University: The Wider Context

Invited guest presentations/lectures/seminars using people who are external to the university are widespread across the university sector. At some stage during a university degree, students are likely to have the opportunity to gain specific knowledge and skills relevant to their field of study. A major expectation of students is to learn about real-world/practical applications and this has been shown to be the case for a school of marketing guest lecturer program (Rowland, 2007). This assertion is also supported by student comments in this case study.

The use of external guest presentations may range from the occasional speaker organised ad hoc by the unit coordinator to an extensive formalised program within the degree structure. The benefits of guest lecturing are not necessarily confined to the students or the given topic. For example, Rowland (2007) suggests that a structured guest lecturing program can also provide opportunities for academics to build research contacts that could even lead to linkage grants.

The structured use of internal guest lecturers across disciplines is not common, despite the obvious advantages of easy access, knowledge of pedagogy and understanding of the university system. Smuncy (2006, p2) proposed that a faculty guest lecturer network be created using faculty staff as guest lecturers at the University of Maryland University College (UMUC) where she also states that “the majority of faculty members may have little idea of the guest lecture possibilities even within their own disciplines”. While this statement may be questionable, there is certainly enormous potential for guest lecturing across the university for academics within their own institution. However, the structures to facilitate this are usually minimal and internal guest teaching tends to rely on personal relationships, word of mouth and good will.

Conclusion

A guest presentation in nuclear radiation has been given separately to environmental and security degree cohorts. Students from all backgrounds overwhelmingly believed that
 A good understanding of the science of nuclear radiation is necessary in their field
 The presentation was relevant and useful

Their understanding and knowledge of nuclear radiation had definitely increased
 Most students also reported that they would like to know more about nuclear radiation applications in their area. The presentation was very successful at meeting student needs, regardless of previous student background in physics and nuclear radiation. The reasons for this are unclear and could be a future research investigation.

Guest presentations provide the means by which students can learn from staff with significantly different expertise to that of the staff who normally teach in their course. This enriches the experience for all participants. Nuclear radiation has been shown here to be a good example of a topic that can be tailored to suit different audiences. The author has also given a nuclear power presentation for undergraduate students in “SCY2402 Industrial Security Procedures” to better understand security risks at nuclear power stations as maximum security installations.

There is an enormous amount of academic expert knowledge, skills and life experiences that could and should be accessible to students through guest teaching/seminars. Unfortunately, the usual financial model at universities, where line managers are encouraged to look after the bottom budget line for their department/school, tends not to encourage the sharing of expertise across cost centres. Innovative and more structured ways need to be

explored to encourage and make possible a much wider use of guest teaching, from all disciplines, across the institution. This could include more formal processes for matching expertise to courses in need and rewarding all those who partake. Universities who can better tap into the expertise within will enhance teaching and learning for global graduates.

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